STRUCTURALLY PRESERVED PLANTS FROM THE PENNSYLVANIAN (MONONGAHELA SERIES) OF SOUTHEASTERN OHIO[1]

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ABSTRACT

Structurally preserved vascular plants have recently been discovered in calcite petrifactions near the town of Shade, Ohio The florule includes representatives of all of the major groups of Carboniferous-age vascular plants, with members of the Calamitales and Marattiales appearing in the highest percentages. The relationships between the Shade coal-ball plants and other coal-ball floras in North America are discussed.

Investigations of fossil plants contained within calcite petrifications known as coal balls have greatly increased our knowledge of the anatomy, morphology, ontogeny, and phylogeny of Pennsylvanian-age plants. Coals balls contain some of the best preserved fossil plants available for critical study. There are, for example, reports of well preserved gametophytes (Brack, 1970), apical meristems (Good and Taylor, 1972), and cell organells (Baxter, 1950) in coal-ball plants. Preservation of these plants is often so excellent that microscopic observations of fossil preparations yield almost as much information about plant internal cellular structure as equivalent preparations of living plants.

Most research on North American coal-ball floras has been based on material of upper and middle Pennsylvanian strata from the Interior Basin of North America, particularly Indiana, Illinois, Iowa, Kansas, and western Kentucky. Much of this work was reviewed by Andrews (1951). Although many coal ball localities have been described from the Eastern Interior Basin (Frankenberg and Eggert, 1969), only two coal-ball occurrences from the Appalachian Basin are noted in the literature (Schopf, 1961; Cross, 1967). To our knowledge, no coal-ball occurrence have been reported in the state of Ohio, but recent inquiries have indicated the presence of at least two previously unreported coal-ball localities in the state.

This is a report of a Pennsylvanian-age petrifaction flora occurring near the town of Shade, Ohio was recently brought to our attention by the efforts of Dr. Arthur H. Blickle, Ohio University. The coal balls occur in the bank of a Shade River Middle Branch tributary known locally as Fossil Run Creek. The outcrop is located in the NW½NE¼ Sec. 21, T 4 N, R 13 W of the Shade, Ohio, quadrangle, 1.0 miles northeast of Shade townsite. Stratigraphically the coal balls occur in a seam equivalent to either the Pittsburgh (No. 8) or Redstone (No. 8A) coals of the Monongahela Series. The stratigraphic section of this area has been measured and is recorded as Section 11536 of the Ohio Division of Geological Survey (Sturgeon, 1958). Although this section indicates that the coal represents a portion of the Pittsburgh Cyclothem, the ubiquitous occurrence of the microspore *Endosporites ornatus* in the petrifactions suggests to us that the coal balls may represent instead a segment of the slightly younger Redstone Cyclothem (Kosanke, 1943; Clendening, 1965).

The coal balls at the Shade locality typically occur as flattened lenticular nodules which in many cases are covered with a hard black slate-like layer of coal. Other nodules, in which the outer coaly layer has been weathered away, appear yellow-buff in coloration. Nodules of a similar size with olive-green coloration also occur at the Shade locality immediately below the coal seam. These

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latter nodules, however, lack any recognizable plant fragments. Although the apparent organic content of the coal balls is relatively high, as evidenced by the very dark matrix observed on cut and polished sections, recognizable and easily delimited plant fragments represent a relatively low percentage of the nodule volume. This is in marked contrast to typical Eastern Interior Basin coal balls, in which the plant material is closely crowded together and represents a high percentage of the total volume. Despite the relatively low frequency of structurally preserved plants, the general level of preservation in Shade coal balls is quite exceptional (fig. 2). These petrifactions range in minerologic composition from specimens of almost pure calcite to others in which the pyrite composition is rather high.

DISCUSSION

The most conspicuous vascular plants represented in the Shade flora appear to be Arthrophytina assignable to the Sphenophyllales and the Calamitales. The Sphenophyllales are represented by vegetative remains of the genus *Sphenophyllum* (fig. 8) and by the reproductive organ *Bowmanites bifurcatus* (Andrews and Mamay, 1951). Large woody axes of the *Arthropitys* type, twigs bearing foliage of the *Annularia* type, and underground axes assignable to *Astromyelon* constitute the vegetative remains referable to the order Calamitales. A new reproductive organ, which shares certain features with the calamitean cone *Palaeostachya*, is also present in the Shade flora (figs. 1, 4, 9).

The second dominant segment of the Shade flora includes representatives ferns and fernlike plants. Organs assignable to the Marattiales include roots of the tree fern *Psaronius* and pinnules bearing sporangia of the *Scolecopteris* and *Eoangiopteris* types (fig. 7). Filicalean ferns are present in the form of sterile foliage and *Anachoropteris* axes (fig. 5). Seed ferns of both the monostelic and polystelic types occur in relatively low numbers in the flora. Stems and foliage of *Callistophyton* (fig. 3) represent the dominant plant type present, whereas *Myeloxylon*-like petioles occur in less abundance. The only ovules that have been observed to date are referable to the genus *Callospermarion*.

One of the most interesting aspects of the Shade petrifaction flora is the relative paucity of vegetative remains assignable to the orders of the Lycopodiophytina. To date, arborescent lycopods are known only from a few specimens of *Lepidophylloides* foliage (fig. 6) and numerous isolated *Endosporites* microspores and *Triletes* megaspores (fig. 2). It is of interest to note that invertebrates of the phylum Gastropoda commonly occur, randomly dispersed among the plant fragments in the Shade coal balls.

EXPLANATION OF FIGURES 1–9

FIGURE 1. Longitudinal section of the calamitean cone *Palaeostachya* (x 5.3). Specimen coal ball #2780 D top, #38.

FIGURE 2. Section of lycopod megaspore. Note the spherical well-preserved fungus (x 38). Specimen coal ball #2581 A bottom, #15.

FIGURE 3. Transverse section of the seed fern stem *Callistophyton* (x 9.6). Specimen coal ball #6050 J bottom, #5.

FIGURE 4. Transverse section of the calamitean cone *Palaeostachya* showing the arrangement of sporangia and bracts (x 9.6). Specimen coal ball #2614 G top, #2.

FIGURE 5. Transverse section of an *Anachoropteris* petiole (x 9.6). Specimen coal ball #6050 N top, #15.

FIGURE 6. Transverse section of the lycopod leaf *Lepidophylloides* (x 14). Specimen coal ball #6052 D top, #3.

FIGURE 7. Transverse section of the marattialena pinnule *Scolecopteris* (x 21). Specimen coal ball #2614 C top, #7.

FIGURE 8. Transverse section of the arthrophyte stem genus *Sphenophyllum* (x 28). Specimen coal ball #6037 D top, #1.

FIGURE 9. *Calamospora* spores macerated from the cone illustrated in Fig. 1 (# 225). Specimen coal ball #2780 C bottom, #7.

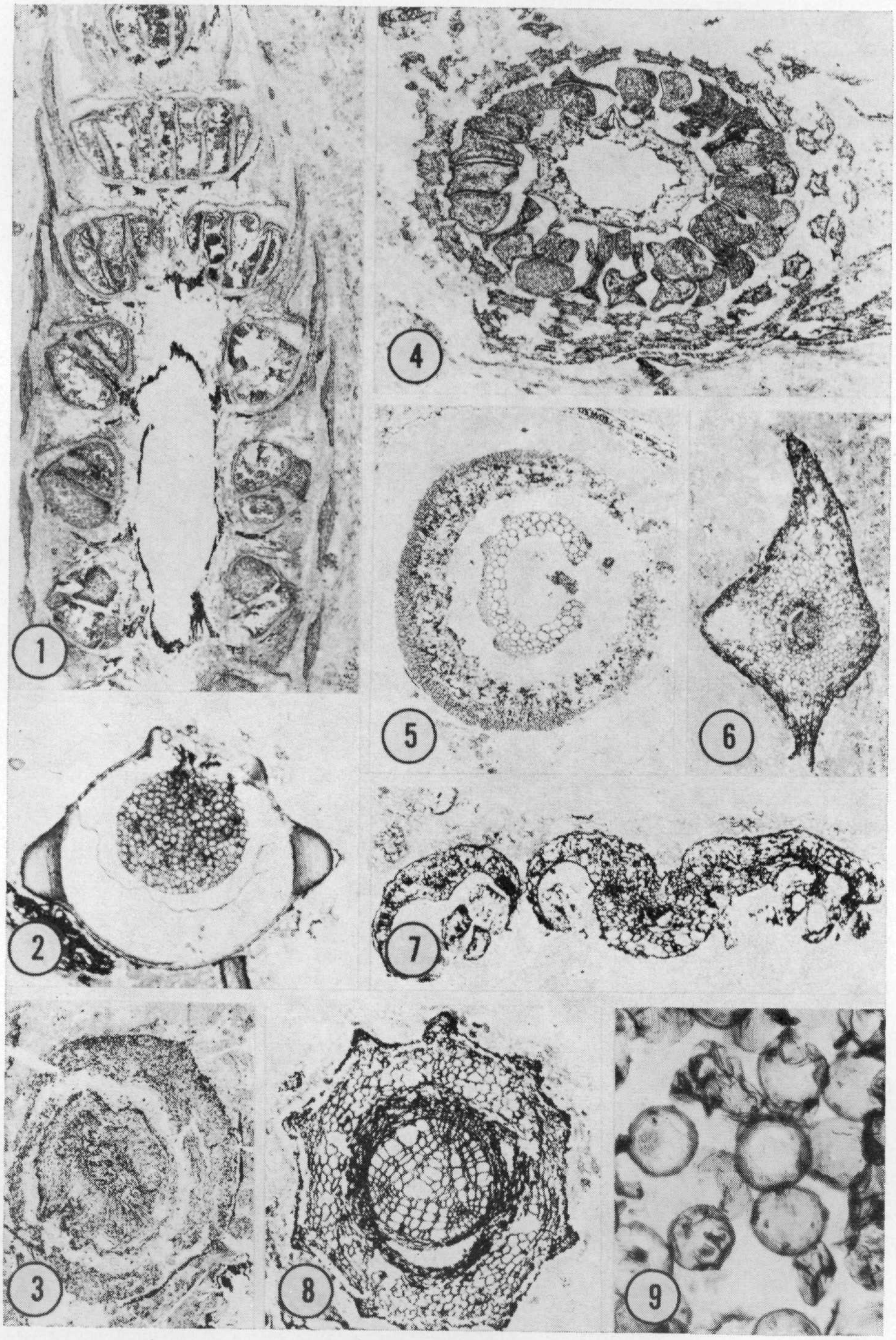

FIGURE 1–9

Several new taxa appear to be present among the Marattiales and Calamitales, according to our preliminary survey of this new coal ball flora. It is our opinion that the Shade floral composition is more similar to the coal-ball floras described from the McLeansboro Formation in the Berryville, Calhoun, and New Calhoun sites (Frankenberg and Eggert, 1969) of Illinois than to any other extensively described coal-ball floras in North America. Both the McLeansboro floras and the Shade flora have relatively few arborescent lycopods represented. Moreover, these sites also share the common occurrences of a relatively large percentage of calamites and marattialean tree ferns.

Since 1838 there have been numerous reports of silicified tree fern trunks of the genus *Psaronius* from strata associated with the Pittsburgh coal in the vicinity of Shade, Ohio (Hildreth, 1838; Herzer, 1897; 1901; 1902; Lesquereux, 1880; Blickle, 1940; Morgan, 1959). One validly published species of *Psaronius*, *P. pertusus* (Morgan, 1959) is known from both the Berryville and Fossil Creek sites, and further underscores the near-contemporaneous nature of the Clahoun Coal of Illinois and the Pittsburgh or Redstone coal of southeastern Ohio.

The discovery of a coal-ball flora in southeastern Ohio and the resurgence of an active coal industry in the state increases the probability that additional petrifaction floras will be discovered and reported upon in the near future. It is hoped that an investigation of Ohio coal balls from several different stratigraphic levels will substantially increase our knowledge of Pennsylvanian-age floras in eastern North America and moreover will provide a useful and much needed method of correlation between strata of the Appalachian and Eastern Interior Basins.

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